DOCUMENT RESUME

ED 237 316 SE 043 324

TITLE	International Expert Meeting on Exchange of Information on Science and Technology Education (Unesco, Paris, October 18-22, 1982). Final Report.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France).
REPORT NO	ED-82/CONF.620/COL.3
PUB DATE	82
NOTE	32p.
AVAILABLE FROM	UNESCO, Unesco Press, 7, Place de Fontenoy, Paris 75700.
PUB TYPE	Reports - Descriptive (141) -- Collected Works - Conference Proceedings (021)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Cooperative Planning; Curriculum Development; Educational Improvement; Foreign Countries; *Information Dissemination; Information Services; Information Sources; *International Programs; *Policy Formation; *Science Education; *Science Instruction; *Technology
IDENTIFIERS	*Information Exchange Procedures

ABSTRACT

Reported is a meeting which was held to review and assess Unesco's activities in the exchange of ideas and information on the teaching of science and technology, and to identify developing countries' priorities in this field. Meeting highlights are presented in four major sections, each addressing different aspects of the exchange of information on science and technology education: (1) objectives and modalities of the exchange, outlining range/nature of information to be exchanged (including information required for policy formulation/implementation, required for curriculum and teacher improvement, on non-formal education, and for general awareness); (2) improvement of national capacities for participation in the exchange; (3) review of current efforts for exchanging such information; and (4) international, cooperative efforts. Suggestions for further action are also presented as related to improvement of both national capacities and international cooperation in the exchange of information in science/technology education. The meeting agenda, the opening address given by Dr. S. R. Samady (Director of the Division of Science, Technical, and Vocational Education), a list of participants, and a list of related documents are included in appendices. (JN)

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INTERNATIONAL EXPERT MEETING ON EXCHANGE OF INFORMATION ON SCIENCE AND TECHNOLOGY EDUCATION

(Unesco, Paris, 18-22 October 1982)

Final Report

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OPENING CEREMONY

1. The meeting was opened on Monday, 18th October 1982, by Dr. Samady, Director, Division of Science, Technical and Vocational Education, who welcomed the participants and observers on behalf of the Director General of Unesco. Dr. Samady indicated that the meeting had a dual function, namely: to review and assess Unesco's activities in the exchange of ideas and information on the teaching of science and technology, and to identify the developing countries' priorities in this field. Dr. Samady's address is attached to this report.

2. The meeting elected the following officers:

Chairman	Dr. George Walcott Dean, Faculty of Natural Sciences Chairman, Committee of Deans University of Guyana, Guyana
Vice-Chairmen	Dr. Chandra Shekhar Jha Educational Adviser (Technical) Ministry of Education and Culture, India
	Dr. David Lockard International Clearinghouse on Science and Mathematics Education Science Teaching Center University of Maryland, USA
Rapporteur	Dr. M.J. Mwandosya Senior Lecturer, Faculty of Engineering University of Dar-es-Salaam United Republic of Tanzania

3. Dr. E. Jacobsen, Secretary of the meeting, outlined the various working documents. He explained that the organization of the meeting would allow time for discussions in working groups as well as in plenary sessions. An exhibition of relevant publications and documents would be set up and participants were invited to contribute to it.

OBJECTIVES AND MODALITIES OF THE EXCHANGE OF INFORMATION ON SCIENCE AND TECHNOLOGY EDUCATION

4. As an introduction to the discussion of this point of the agenda, the meeting decided to review first the range and nature of the information to be exchanged, as well as the various types of users of this information.

The range and nature of information to be exchanged

This could be grouped under the following categories:

- information required for policy formulation and implementation;
- information required for curriculum improvement;
- information required for teacher improvement;
- information on non-formal education;
- information for general awareness.

(a) Information required for policy formulation/implementation:

(i) strategies and policy papers ;
(ii) studies and reports on various aspects of science and technology education ;
(iii) research studies in teaching of specialist subjects at different levels including work of specialized centres for science education ;
(iv) low-cost science and technology equipment - use of indigenous resources.

(b) Information required for curriculum improvement:

(i) publications dealing with curriculum development, such as Unesco's New Trends Series ;
(ii) curriculum development information, material and packages in the following subject areas for various levels of education, and for integrated approaches:

mathematics	technology education
biology, chemistry, physics	primary science
environmental studies	integrated science
computer studies	science and society
energy-related studies	links between science mathematics and technology;

(iii) information on equipment selection, modification for special application and maintenance;
(iv) innovations in laboratory and workshop instruction.

(c) Information for teacher improvement:

(i) teacher education programmes:
- new approaches to science teacher education
- upgrading courses for primary teachers
- in-service courses for science and technology teachers
- special courses for teachers to introduce technology education in primary and secondary schools.

(ii) teacher support programmes:
- audio-visual packages
- computer assisted instruction
- sourcebooks and handbooks for teachers
- textbooks and teachers' guides
- model syllabi
- evaluation and assessment techniques.

(d) Information on non-formal education:

(i) correspondence courses, distance learning techniques and programmes;
(ii) continuing education programmes for students and adults;
(iii) science centres/science clubs;
(iv) science camps/science fairs;
(v) science and technology museums;
(vi) associations (including junior associations) for advancement of science;
(vii) journals and bulletins specifically designed for non-formal education;

(e) Information for general awareness:
newsletters; journals and bulletins; bibliographies;
national/international facilities; library holdings.

5. It was agreed that the purpose of the exchange of information under discussion is to assist in the process of development of education, in particular to improve science and technology education and to strengthen the contribution that this part of the educational system can make towards social and cultural development, keeping in mind the needs of individuals and of their societies.

Hence, a wide range of information was identified and discussed. The main needs seemed to fall in the following categories:

- sourcebooks and handbooks for teachers, in which they could find information applicable to their own classroom situations;
- textbooks and teachers' guides;
- studies and reports on various aspects of science and technology education;
- results of research work in the area of science and technology education, application of research results, as well as methodological materials that might help teachers to engage in this type of research;
- syllabi, examinations assessment, evaluation and other information on new curricula;
- papers on strategies and policies;
- the place and the possibilities of computers in science and technology education;
- journals and bulletins;
- newsletters;
- audio-visual packages;
- bibliographies.

6. There was an interesting discussion in connection with research in the field of science and technology education (cognitive development of children, problems related to the learning of certain concepts, language problems, etc.) More information on both methodology and results should be made available to teachers and in particular to curriculum planners; better arrangements, in the form of institutional links, should be made in order to collect information on this kind of research done in universities and other research centres; appropriate exchanges of information are needed to ensure that the results of this research are applied to actual classroom situations in order to improve learning; information ought to be made available also on research results that describe successes as well as failures of educational projects.

7. The discussion on computer education revealed that a number of aspects have to be considered, grouped in three main types: teaching the pupils about computers and how to use them; teaching the teachers how they can teach better with the help of computers; using computers as tools for the exchange of information. Furthermore, this whole area of computer education was considered important because of its many applications and urgent, in view of the fast technological changes. Careful analysis is needed in order to avoid expensive mistakes. It was also stressed that the computer could in no way replace the "human factor" and that the use of the computer to education is to make easier the work of the teacher and student. The participants also stressed that the introduction of techniques requiring the computer and informatics should not under any circumstances mask the real problems that the

developing countries encounter in attempting to improve conditions for the teaching of science and technology.

8. Part of the discussion on computers concentrated on the use of hand-held electronic calculators for the teaching of mathematics and science -- now that their cost is, in most countries, more or less equivalent to that of a standard textbook. These hand-held electronic calculators are already used in many constructive ways, and a better exchange of information on their effects on teaching and learning could be most valuable for all countries.

9. The area of curriculum development was singled out as one of those where a more efficient exchange of information could be of great help. For instance, regarding mathematics education, results of evaluation of new curricula should be known more widely so as to avoid some of the mistakes of recent years. The same was said of primary school science curricula, especially for those countries where an appreciable fraction of pupils leave the educational system after only a few years at school. A wider exchange of information is needed also on problems such as: how to emphasize an equiry approach and teach for understanding and problem-solving rather than merely scientific facts; how to facilitate the task of those who are trying to design integrated (or unified) curricula by bringing in problems related to health, nutrition, agriculture, industry, energy, etc.; how to pay due attention to technology as part of regular science courses.

10. Another important area covered by the discussions is that of teacher education. The advent of new curricula and new approaches to teaching science and technology has important implications for teacher education. The general problem, encountered in many developing countries, of underqualified or unqualified teachers also has major implications for teacher education and the upgrading of teachers. Thus, information on pre-service and in-service education of teachers and on methods, including distance education, for the upgrading of teachers must be shared with those throughout the world who are responsible for teacher education. Such information includes, for example: handbooks for teachers, other forms of teachers' guides, reports of special training courses, etc.; and obviously teachers should themselves participate in courses aimed at helping them to perform more effectively for the benefit of their pupils.

11. In addition to information on the various aspects of the formal school system, there was a recognition of the importance of out-of-school or non-formal education, for school-age children as well as for adults, and of the dissemination of information on developments in this area. This information would include aspects related to : science and technology clubs, science olympiads, science fairs, science and technology camps, research projects by young people, special scientific congresses for school students engaged in research, institutional arrangements for promoting and facilitating such activities, science and technology museums, special journals and magazines, national associations for the advancement of science and technology education; the use of the mass media (press, radio, television for popularizing science and technology), special prizes for teachers who have done some exceptionally significant work for the improvement of some aspect of science and technology education, production and wide distribution of science and technology kits (which could also be sold as toys and games).

12. The subject of equipment for the teaching of science and technology also received special attention. Information in this area is needed by both classroom teachers and by curriculum planners and policy makers. Exchange of information is needed between the specialized centres that design, develop, manufacture, distribute and repair such equipment. But this information should also reach the users: the teachers; and it should reach them in usable forms: books, newsletters, sheets giving designs, hints for maintenance and utilization, ideas on efficient use of classroom space in the absence of special facilities, etc.

13. Throughout the discussion it was felt that a clear distinction has to be made between the various types of information, and also between the different types of users of this information; and the exchanges, in order to be of maximum benefit, must make sure that each type of user has access to the kind of information that is most relevant to his/her particular situation.

The users and generators of information

14. In discussing this item, it was agreed that the users of information are very often also the generators. For example, curriculum developers and designers of equipment require information on similar developments elsewhere in the world, but they themselves contribute to the pool of information in the course of their work. The following categories of users and generators in science and technology education were identified:

-Policy and decision makers, who have the responsibility of deciding on and stating overall goals for science and technology education.

-Administrators - those who are managers or directors of educational institutions and who are planners of programmes in science and technology education.

-Teachers - those practitioners who carry out the tasks of teaching science and technology at all levels in the education system.

-Students in schools and colleges.

-Science and technology curriculum development workers and other research workers who are often prime generators of information.

-Teacher educators, inspectors and advisers.

-Parents and the public - all of whom have an interest and a national stake in the system of education.

15. Information needs vary considerably from one category to another. At one end of the spectrum, the policy makers who are concerned with broad issues of science and technology education need generalized information, often on a comparative basis. Teachers, on the other hand, need specific information relating to their job as practitioners, including teaching methods, equipment designs, curriculum guides, etc. It was agreed that for each category of users, the specific information needs must be identified.

Objectives, modalities and mechanisms

16. The following major objectives of information exchange were agreed upon :

- to promote the modernization and relevance of science and technology education by international co-operation;

- to promote co-operation between those individuals, institutions and organizations involved in the improvement of science and technology education;

- to improve methods of teaching and learning; and

- to share and benefit from experiences on new approaches, curriculum projects, resource materials and equipment, including the applications of new technologies in science and technology education.

17. In discussing various forms of both oral and recorded information, it was agreed that a distinction needs to be made between science and technology education information as such (curriculum materials including textbooks, teachers' guides, syllabi, etc.) and information about such information (bibliographies, newsletters, etc.). It was felt that, whenever possible, direct access to the information itself was desirable but that a variety of constraints such as size, weight, number of copies available, problems of postal services, etc. did not always make this feasible. In such cases abstracts and summaries could be very valuable. It was also agreed that greater use should be made of computerized information services, but that problems of cost and lack of trained personnel, especially in developing countries, were serious obstacles. The importance of library services was stressed.

18. There was general agreement that oral information through direct personal communication is important. It was felt that conferences, meetings and seminars organized by Unesco were very useful, especially when there was some follow-up activity such as a publication or establishment of an information network. It was also agreed that, for an organization such as Unesco to be kept fully informed about developments in Member States there was no substitute for periodic staff visits.

19. In discussing Unesco publications, emphasis was placed on the importance of quality. It was felt that, in the past, the quality of Unesco's publications in science and technology education had been high, and it was recommended that this quality should be maintained. The problem of distribution of Unesco publications was raised and it was agreed that every effort should be made to improve this distribution. There was often a lack of awareness of what publications were available. In many countries there was also a problem of accessibility of these publications.

20. In discussing mechanisms, it was agreed that the real concern was for the right information to reach the person who needs it. Various mechanisms, such as specialized education centres, professional teachers organizations, national depositories of U.N. documents, information networks, and meetings of various kinds were discussed. It was felt that all such mechanisms were valuable and that, within a given country, a diversity was desirable. Emphasis was placed on the importance of Unesco association with, and support for, existing international and regional mechanisms. It was suggested that geographically-restricted and programme oriented networks (such as a central and southern African

network for primary-level mathematics education) could be particularly effective mechanisms.

IMPROVING NATIONAL CAPACITIES FOR PARTICIPATION IN THE EXCHANGE OF INFORMATION

21. The principal initiators of information on science and technology education include government organizations (e.g. ministries and their departments, information centres, local education authorities, education and curriculum centres); research councils, academies of sciences, universities, polytechnics and their various faculties; teacher training colleges; field-study centres; museums, parks and zoos; non-governmental organizations for the promotion of science and technology education (e.g. teachers and their associations, other similar professional and voluntary organizations); journals, bulletins; newsletters, project documents, as well as mass-media activities for the popularization of science and technology.

22. The basic aims of an information system are to collect, process, store and disseminate relevant information in the most appropriate form to those who need to use it. Existing national mechanisms for information exchange vary considerably from country to country and need further development.

23. To improve the situation, it was suggested that efforts be made to bring about greater national awareness of available information on science and technology education and promote its dissemination in order to make science and technology an integral part of everyday life.

24. Information systems being basic to the development process, the need was stressed to study and develop different types of models based on existing resources, structures and mechanisms, for the exchange of information on science and technology education.

25. In view of the fact that many countries lack trained manpower capable of handling science and technology information, it was emphasized that special programmes and courses such as national workshops, seminars, and in-service training courses be initiated and developed for the training of personnel to meet country-specified needs. Furthermore, it was stressed that efforts should be made to include teacher training programme components related to national and international sources of information, and methodologies for obtaining such information.

26. In teaching science and technology, emphasis should be placed on methodologies in seeking and applying knowledge for solving daily problems rather than on the simple memorization of facts.

27. To form a nucleus that can be developed at a national level, schools and other users of science and technology information should be adopted as part of the network.

28. Science and technology being an integral part of today's world, it was stressed that serious efforts should be made to involve the mass media and social and welfare organizations in attempts to popularize science and technology knowledge and its application to daily life.

29. In order to strengthen and promote the flow of information on science and technology at national level, it was suggested that measures be taken to bring out science and technology abstracts, an index of research

theses, journals and articles, profiles of curriculum development and teacher training projects, a register of workshops and meetings and lists of resource institutions and persons, etc., for curriculum in the country. Personal exchange of information through institutions, seminars and workshops should be encouraged.

30. For improving regional and international capacities, in view of the importance and necessity of optimising available resources, emphasis should be placed on the development of various regional and international models for information exchange based on existing structures and mechanisms rather than on the creation of new ones. It was therefore suggested that links and operational mechanisms be explored with UNISIST and other similar networks, centres and organizations operating in different regions of the world.

31. In linking different countries in the region or worldwide, the guiding point should relate as much to common socio-economic and educational problems as to the geographical position of the participating countries. The need for exchange of information between developing countries was also stressed.

32. Essential to regional and international networks for exchange of information on science and technology education is the national structure. Member States should be encouraged to develop the necessary policies, plans and administrative structures for effective coordination of local structures for the exchange of materials related to science and technology education at regional and international levels.

33. While many regional/international organizations cannot be expected to house the full range of national materials (textbooks, project documents, etc.) from different countries, it would be realistic for them to receive the abstracts, brief reviews, index and profiles, etc. on science and technology education, as indicated earlier for the improvement of national capacities in science and technology information exchange.

34. To facilitate science and technology education information exchange at regional and international levels it was also suggested to produce specialized directories of institutions and organizations dealing with the subject.

35. Language differences require special attention. Each country participating in the network should decide upon the language in which to retrieve and disseminate information on science and technology education.

36. In addition to language, finance and foreign exchange are major constraints in developing information exchange systems. To overcome this, possibilities should be explored on the use of local currency for acquisition of educational information and also for development and utilization of regional satellite programmes to reach a wide audience.

37. To examine further the amelioration of national capacities for the exchange of information in this field, a working group was constituted. Their report, presented, modified and approved in a plenary session, is as follows.

38. Currently the demands and requirements for the dissemination of information on science and technology education within national boundaries often exceeds the capacity of Unesco National Commissions to provide these services.

39. The International Congress on Science and Technology Education and National Development (Unesco, 21 November - 2 December 1981) has recommended the following:-

- The establishment of local, national and regional clearing houses in science and technology education;

- National governments in developing countries should set up policy-making, planning and implementation groups so that national and international efforts may be more effectively channelled towards the endogenous development of each country.

40. Any improvements in the exchange of information in science and technology education must be designed to reach the teachers of mathematics, science and technology effectively and must also permit and encourage teacher participation in the production and exchange of this information. It is essential to bear in mind that it is the teacher who is the final disseminator and catalyst in science and technology education. It must also be recognised that, to enable teachers to perform effectively, it is necessary that principals, school supervisors and inspectors, administrators and policy makers be equally well-informed in relation to science and technology education documentation.

41. There will be requirements for the training of personnel in information dissemination and retrieval methods involved in the implementation of any proposals made in this connection. The recommendations for both international and national programmes should include consideration of this aspect.

42. As an increase in national capacities for information exchange is also implied in these considerations, attention is drawn to the fact that, while traditional methods of documentation have often been inadequately used nationally, they do have expensive, ongoing manpower implications. In this connection attention is necessarily drawn to the computer, especially the modern microcomputer, with its low capital cost and low manpower requirements for effective operation.

43. While the current recommendations will refer mainly to Unesco publications, sponsorship and international activities, such recommendations should also be taken to apply to all international and national organizations involved in the production and dissemination of information on science and technology education.

REVIEW OF CURRENT EFFORTS FOR THE EXCHANGE OF INFORMATION ON SCIENCE AND TECHNOLOGY EDUCATION

44. Much of the discussion under this heading dealt with publications, in view of the role they play in an international exchange of information. It was suggested that - apart from the books and professional journals produced and distributed all over the world on a commercial basis - there should be three additional types of publications, with a frequency appropriate to each of these types:

- Newsletters or bulletins for disseminating urgent information, such items as: news of forthcoming meetings, references to innovative projects, summaries of reports and significant publications. These newsletters should be produced and distributed very rapidly; and their frequency should be determined by the needs and by the availability of the relevant information. As examples, reference was made to the newsletters produced, with the help of Unesco, by the Education Commissions of ICSU and its International Scientific Unions. It was also proposed that occasionally a newsletter might focus on a particular theme or type of activity, depending on the needs.

- A series of publications similar to Unesco's Studies in Mathematics Education , with a frequency of about one issue per year.

- Publications of Unesco's series on New Trends in the Teaching of Biology, Chemistry, Mathematics, Physics, Integrated Science, etc. These should provide surveys and historical perspectives on recent developments in each of those areas. The frequency, for each subject, might be one issue about every seven years, depending upon developments within the teaching of the subject.

45. Regarding Unesco's present publications, in particular the "New Trends" series, the New Unesco Sourcebook for Science Teaching and the series Studies in Mathematics Education, their content was considered good and appropriate. Suggestions were made to widen their scope, for instance by having publications on New Trends in Technology Education, each of them focussing on specific aspects or on specific sets of needs, and perhaps a series on Science Education and Community highlighting the implications and the applications of science and technology to the community.

46. Regarding the availability of Unesco's publications, two serious problems were mentioned : the publication process is too slow, and their availability and circulation is much too limited due perhaps to inefficient distribution mechanisms. A typical circulation figure for an issue of a "New Trends" volume is about 5000 copies -- a small figure considering it is supposed to circulate worldwide. Several ideas were proposed to improve this situation:

- that Unesco might send more free copies of its publications to teachers who need them and could benefit from them, perhaps through schools and teacher training institutions;

- that Unesco encourage and assist its Member States to translate and/or reproduce the relevant publications for further internal circulation, a task in which universities might be involved in view of the printing facilities they often have, as well as their contacts with teachers and teacher training programmes;

- that Unesco collaborate more closely with national associations of science teachers, with regional science education organizations and with the International Council of Associations for Science Education (ICASE) in the distribution of publications;

- that Unesco advertise its publications in national and international professional journals in the fields of science and science education; and

- that some of Unesco's publications be published or reprinted in collaboration with commercial publishers.

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47. Regarding the establishment of focal points, or nodes of a network for the exchange and dissemination of information, the role of Unesco - both Headquarters and Regional Offices - was acknowledged. It was suggested that some universities, teacher training institutions, scientific societies and associations of science teachers could also be considered, as well as national committees for promotion of science and technology education that might be formed for that purpose.

48. Regional and international in-service training courses and workshops were considered an important and efficient way of disseminating information in a manner that is useful to the teachers. Unesco was urged to sponsor a larger number of such courses and to help the participants of these courses in their efforts to organize national seminars and workshops which would have a multiplying effect.

49. In discussing the role and modalities of Unesco in the area of science and technology education, it was recognized that Unesco can provide funds, organizational capacity and the professional expertise of its specialists. All three were considered important, and it was suggested that the latter might be increased through a more frequent participation of Unesco personnel in its own seminars, workshops and training courses, as well as in such activities organized by other competent bodies.

50. The work of other organizations represented at the meeting was described, in particular regarding the exchange of information on science and technology education : the Committee on the Teaching of Science of the International Council of Scientific Unions (ICSU/CTS), the Education Department of the Commonwealth Secretariat, the International Clearing House on Science Education Projects, and the Education Department of the British Council. Their representatives referred to successful and useful examples of activities carried out in collaboration with Unesco, and recommended that such co-operation be continued, and suggested that more frequent visits of Unesco specialists to their meetings and projects -- and vice-versa -- could be of mutual benefit and thus of benefit also to the Member States.

INTERNATIONAL CO-OPERATION IN THE EXCHANGE OF INFORMATION IN SCIENCE AND TECHNOLOGY EDUCATION

51. Another Working Group was constituted to examine international co-operation, and in particular:

- To reflect on general guidelines for developing and improving international exchange of information.

- To identify priorities for, and recommend action on, the exchange of information at the international, regional and sub-regional levels.

Their report, which was discussed and approved in plenary session, is as follows.

52. The group reviewed and confirmed the value of the wide range of publications which Unesco issues from time to time. It agreed that Unesco should continue to carry out its publishing programme highlighted in page 2 of the Working Paper. However, it expressed concern at the almost complete absence of information on technological education in the existing publications, and the lack of clearly stated policy governing the freqency of issue of Unesco publications.

53. Regarding the former, it was agreed that Unesco's regular, periodical and occasional publications should henceforth be extended to include technology education, with particular reference to (a) the training of teachers who would introduce the subject into primary schools, (b) the use of equipment by teachers at the secondary level, (c) the training of technicians, (d) the inter-relationship of science, mathematics, and technology education, (e) content and methodology of technology education at various levels, and (f) training of educators and promoters in non-formal education in technology.

54. Considering the freqency of publications which is a more fundamental issue, the group felt that any Unesco policy formulated should take into account such criteria as: urgency to communicate a particular type of information, rapid changes in a particular subject area or field, cost-effectiveness, etc. It was decided to recommend that Unesco adopt the following pattern for its regular publications and distribution in each of the main fields of science, mathematics and technology education:

a) a frequent (3 or 4 month intervals) newsletter of current information and notification of forthcoming events;

b) an annual journal (in the style of the current Studies in Mathematics Education) to contain a series of commissioned articles on some aspect of current international concern in a particular subject area;

c) an annual review of the outcome of major national, regional and international meetings; in this case, a single annual publication might cover the whole field of science, mathematics and technology education;

d) a less frequent series of books, in the form of "New Trends", perhaps once every seven years, to survey major developments in the field and to act as a definitive historical record of such developments.

55. In relation to the "New Trends" type of publication noted in 54 (d) above, an issue which was also raised was the method used for its production. The group agreed that there was no single method to do so. However, it was suggested that when the "New Trends" series on technology education (see paragraph 53 above) is being introduced, Unesco should, at a very early stage, bring together a group of experts to define the conceptual framework for technology education.

56. On another matter relating to policy, the group recommended that Unesco's publications should be updated, particularly when reprinted at long intervals. More specifically, it was suggested that the Sourcebook for Science Teaching, which requires reprinting, should again be updated.

57. The group reviewed and assessed the effectiveness of the various types of meetings in which Unesco participates worldwide. It agreed unanimously on the value of the oral communication of information through conferences, seminars and workshops. Further it categorized such meetings into three, in decreasing order of cost to Unesco:

a) international meetings organized wholly by Unesco;

b) regional meetings organized wholly by Unesco;

c) international, regional or national meetings organized jointly by Unesco and a national and/or another international agency.

58. Each of the above types of meetings has its place and performs particular functions. For instance, 57 (a) above is best when there is need for commonality of policies and definition of strategies for the long term. The current meeting on exchange of information is a case in point. However, meetings of this type in 57 (b) and (c) are best for helping to strengthen regional and national capacities and for increasing the multiplier effect which Unesco aims to achieve in its programmes. The group recommended that:

a) the frequency of Unesco-organized international conferences be low;

b) Unesco develop its capacity to organize regional meetings jointly with national and/or other international agencies. The initiative for such joint activities could come either from Unesco or from another body. In general, Unesco's contribution to such jointly organized meetings could take such forms as: part-funding; professional input; the use of Unesco's mechanisms, both in preparing for and during the meeting, and in follow-up activities;

c) Unesco explore the possibility of including in its General Conferences and in the international meetings, specialized subjects or themes of discussion.

59. The group reviewed the documentation function being carried out both at Unesco headquarters and within the various Unesco regional offices. It noted, in particular, that the Science and Technology Education Information and Documentation Centre, established at Unesco Headquarters to provide documentation for science educators in Member States for Unesco field experts, and for Unesco staff is presently able to function merely as an input system. In order to perform adequately its proper functions, the group recommended that the Centre's resources be augmented and methodology computerized to permit it to act as a major resource information centre for wider storage, retrieval and dissemination of information.

60. Further, the group endorsed the value of networks in the collection and dissemination of educational information. However, in order to increase the effectiveness of networks, the group recommended that institutions linked in any international network should be urged to take as one of their responsibilities the creation of sub-networks in their individual countries. Also, it was agreed that, in order to play an effective role in, and thus derive the maximum benefit, from any international network scheme, each country should decide the language (this should preferably be an international one) and identify the nodal points, for receiving and transmitting information.

61. The group recommended that an international network for science and technology education be set up linking the existing international resource and information centres at Unesco and other bodies engaged in international exchange with the regional and sub-regional information centres and national resource/information centres. It is also recommended that every attempt be made by all concerned to optimize the network resources for widest possible dissemination.

62. To make the most effective use of the proposed international network, it would be necessary to train a large number of information scientists in modern methods of information storage, retrieval and dissemination.

These scientists would be required for manning the nodal points in the network at the national, sub-regional, regional and international levels. It is recommended that Unesco investigate the possibility of organizing such training programmes at national/regional levels.

63. For nurturing the network in the collection as well as dissemination of information, the group felt it desirable that Unesco staff develop extensive personal contacts with the Science and Technology educators in the field. The development of such contacts would need periodical visits of Unesco staff to field units engaged in information generation and/or dissemination.

SUGGESTIONS FOR FURTHER ACTION

64. The meeting appreciated the role of information systems in the economic, industrial and social development of a country. It was mentioned that information has become so important that the existence of a good information system has now become a significant parameter in determining the level of social, economic and industrial development of a country. In this context, the meeting suggested that Unesco and other international agencies should give special efforts to enhancing the national capacities of developing countries in the general field of information collection, processing and dissemination, with particular reference to science and technology education.

65. The following suggestions for further action addressed to Member States, to Unesco and to other organizations were made by the meeting.

Those concerning the improvement of national capacities for the exchange of information on science and technology education

66. All Member States should be requested by Unesco to designate a national centre or centres for dissemination of information on science and technology education, and to coordinate this work in co-operation with the Unesco National Commissions and other international bodies.

a) The Unesco National Commissions should advise, when requested, on the size and number of such centres in relation to national needs.

b) The establishment of such national centres should also be aligned to liaise effectively with international or regional centres for the international exchange of information.

67. Once such national centres have been designated, a national network for the dissemination of information on science and technology education should then be established.

a) Such a network should be used for both dissemination and for collection of such information on a national basis.

b) Existing institutions or bodies which could be involved are as follows:

- ministries, state secretariats or departments of education both at national and local levels;

- university, college or polytechnic
  departments
  faculties
  institutes
  research centres
  libraries.

- teacher training institutions

- curriculum development centres

- national libraries

- national institutes or research centres

- national councils or academies of science and technology

- professional associations or institutes

- non-governmental organizations

- non-formal education groups

- special interest groups

- individuals.

c) Such a national network could be used for a variety of educational purposes.

68. Unesco should transmit all of its currently circulated material on science and technology education to the National Commissions, national centres and to mutually agreed locations in the national networks. Other international organizations circulating such information should be encouraged to do the same.

69. The national networks will probably need to circulate more copies of information material than Unesco or other international organizations could provide. In such cases the following policies should apply:

a) Such material should be permitted to be copied, unaltered, to whatever extent may be necessary.

b) Legitimate costs of translation, duplication and postal or other transmission may be charged to the consumer on a non-profit basis if national resources are not available to defray these costs.

c) It should be regarded as permissible for the national centres or network to use whatever reprographic facilities may be required, whether governmental, institutional or commercial.

d) Each publication so circulated to centres and networks should be clearly identified as being in one of the following categories:

- unrestricted copying permitted;

- copying restricted in specified regards;

- copying not permitted without written permission;

- copying prohibited.

In all cases in which copying is permitted, the originating body, transmitting the material, should be informed and the assistance acknowledged.

70. National capacities for increased information exchange must be generated, including the collection, processing and dissemination of information. In this connection it is recommended that computer techniques be employed in the national and international systems to be developed.

a) Microcomputers should be seriously considered as a basic tool in these processes. These could probably be afforded by many countries.

b) Programming should be developed which would facilitate not only information exchange between national and regional centres but also between national centres in different countries.

c) These programmes should include not only science and technology information material but also lists of names and addresses of coordinating centres and recipients. In this way it would be possible to easily abstract both specific information and relevant addresses at any time.

71. It should be recognized by the national centre (s) that a variety of participants in the information dissemination system exist.

a) Active participants - such as university departments, interdisciplinary groups or research and development centres which may be expected to produce and disseminate the required types of information.

b) Passive participants - such as national and provincial libraries which may act more as repositories and access centres.

c) Awareness participants - whose function is to seek out, evaluate and report on problems of learning in special areas, such as mathematics, technical and science education.

d) Interactive participants - such as national or university institutes whose constitution entails a partnership operation between educational institutions, government departments and interest groups for a common set of purposes.

e) Individual participants.

72. Interactive mechanisms should also be identified through which the national network could carry out its functions. These would include:

- teacher associations;
- teaching practice supervisors;
- examiners and moderators;
- research field workers;
- inspectorate or advisory staff on tour;
- individuals:
- meetings involving persons listed above with other experts for special purposes of planning, coordination or instruction.

73. Staff training will be necessary in the development of national information networks.

- Models for the training of personnel to man information exchange centres should be prepared which can be used in seminar-workshops for international, regional and national network staff.

- In order to achieve a standard training system, and for the better coordination of information exchange generally, guidelines must be established, preferably under Unesco auspices, for the development of educational information system data bases. This is particularly necessary in science and technology education in view of the potentially vast amount of information accumulating.

74. Standard data forms must be aimed at facilitating compatibility of all the international and national information exchange systems.

75. The information required for circulation between centres should be produced from national sources in the form of bibliographies, indexes, periodical lists, etc. National networks should accept primary responsibility in this regard. International organizations should augment this work on an international basis for exchange between regional centres.

76 The following information requirements at the national level should be catered for in view of science and technology education :

- educational research abstracts

- book lists available in national libraries

- lists of available equipment in national locations

- locations and details of collections in museums, field centres and national information exchange centres.

77. Science and technology education information should be used to encourage the development of creativity in students and their ability to think for themselves.

Those concerning the improvement of international co-operation in the exchange of information in science and technology education

78. Unesco shall consider adopting the following pattern for its regular publications in each of the main fields of science, mathematics and technology education:

- frequent (3- or 4-monthly) newsletter of current information and notification of forthcoming meetings (cf. Connect);

- an annual journal, in the style of Studies in Mathematics Education;

- an annual review of the outcomes of major national, regional and international meetings;

- a less frequent series of books, in the form of New Trends, perhaps once every seven years.

79. Unesco's occasional publications should be updated when necessary when they are reprinted; and in particular, the Source Book for Science Teaching should again be updated and reprinted.

80. Both regular and occasional publications, as noted in suggestions above (paragraphs 78 and 79) should be extended to the field of technology education, with particular reference to the problem of teacher preparation for technology education at primary school level.

81. Unesco should convene an international meeting to explore the issue of technology education at primary school level, in preparation for the implementation of the suggestion in paragraph 80 above.

82. Unesco should develop its capacity to organize regional meetings jointly with national or other international agencies. The initiative for such joint organization could come either from Unesco or from the other body.

83. Unesco should explore the possibility of including in its General Conferences and in the international meetings, specialized subjects or themes of high topical interest for discussion.

84. The international collection of documents held in Unesco's Science and Technology Education Information Centre should be listed in computerized form, and thus a proper documentation service will be made available to enquirers, to replace the existing ad hoc method of response.

85. Unesco should consider preparing a series of case studies on the functioning of existing national and regional centres that are at present active in the field of information exchange in science and technology education and making these case studies available world-wide as a way of encouraging and helping in the setting up of such centres - both regional and national - where they do not yet exist. Unesco should also support a number of field studies in selected countries to enable national networks to be established with a view to undertaking the preparation of policy papers relating to science and technology education, bibliographies, abstracts, etc., as exemples of the activities of national centres.

86. An international network for the dissemination of information in science and technology education should be initiated by Unesco, linking the existing resources of Unesco and other bodies working in this field.

87. Attention shall be given to the training of personnel at both regional and national levels, to operate the information networks recommended in paragraph 86.

88. Unesco should use the capacity of its professional staff concerned, both at regional offices and in Headquarters, to travel more frequently in order to nurture the network recommended above.

89. Apart from official relations between Unesco, government agencies and Member States, greater efforts should be made to establish more direct contacts and working relations between Unesco and institutions/groups active in the improvement of science and technology education (including science teacher associations, teacher training colleges, educational committees of national and international scientific organizations).

90. Unesco should play a more dynamic role in promoting awareness at national, regional and international levels of the need for a wider and more effective flow of information in the field of science and technology education.

ANNEX I

AGENDA

1. Opening session

2. Election of officers of the meeting.

3. Consideration of the provisional schedule of work.

4. Objectives and modalities of the exchange of information on science and technology education.

5. Improving national capacities for participation in the exchange of information.

6. Review of current efforts for exchange of information on science and technology education.

7. International co-operation in the exchange of information on science and technology education.

   7.1 Identification of priority areas with special reference to the needs of developing countries.

   7.2 Co-ordination for the exchange of information.

8. Suggestions for further action.

9. Adoption of the report.

10. Closing session.

ANNEX II

OPENING ADDRESS GIVEN BY THE DIRECTOR OF THE DIVISION OF SCIENCE, TECHNICAL AND VOCATIONAL EDUCATION AT THE INTERNATIONAL EXPERT MEETING ON EXCHANGE OF INFORMATION ON SCIENCE AND TECHNOLOGY EDUCATION

Ladies and Gentlemen,

On behalf of the Director-General of Unesco I have great pleasure in welcoming you to this meeting. The convening of this meeting was foreseeen in Unesco's programme of activities for 1981-83 (paragraph 1084 of the document 21 C/5) to review the activities of the Organization in the exchange of information on science and technology education and to identify the priorities of the developing countries in this field. I wish to thank you all for having accepted the Director-General's invitation and in so doing for giving him your support and the benefit of your experience.

Over the past years, there has been throughout the world a significant evolution in the general attitude towards science and technology education. Science and technology education, sometimes considered in the past as specialized teaching, is now universally recognized as a basic component of general education and a vital factor for the progress of society. Science and technology education is now considered an essential condition for true democratization of education in that it helps to prepare new generations for active life while contributing towards their personal fulfilment and enabling them to meet their economic, social and cultural needs.

Some of the essential tasks of education are to impart basic scientific and technologic knowledge necessary to prepare the younger generation for an increasing number of occupations, especially in the productive sector; to encourage scientific and technological vocations; and to foster awareness among young people and adults of the inter-relationships between science, technology and society. By these means, education can help to create a favourable climate for scientific and technological development.The teaching of science and technology is also a powerful means of stimulating creativity among young people. Such teaching therefore has its place in the curriculum at all levels - primary, secondary and higher - and in both the formal and non-formal educational systems. Scientific and technological development cannot be properly pursued without efforts for public understanding of science and technology by means of out-of-school activities and through programmes of popularization and extension.

Knowledge in science and technology is developing rapidly. Efforts are being undertaken in many regions of the world to modernize the content of science and technology education and to promote innovations in this field. Hence the pressing need to encourage and facilitate a wider exchange of ideas and information between Member States on science and technology education. This exchange is essential for the improvement of science education by adapting it better to the needs of pupils and society, particularly in the developing countries.

As you are aware - and the working document prepared for this meeting provides some details - over the last few years, Unesco has

undertaken some important activities in this field. In this connection, one can mention the series of publications entitled New Trends in Science Teaching, which covers mathematics, biology, physics, chemistry and integrated science teaching; the Unesco Sourcebook for Science Teaching, which has been translated into more than 30 languages; and the Unesco Handbook for Science Teachers. A new series on Studies in Mathematics Education has recently been initiated. Apart from these major publications, Unesco, in collaboration with competent organizations and institutions and through the specialized services of its Headquarters and Regional Offices, disseminates technical documents, reports on innovative experiences, periodical newsletters, directories, bibliographies, etc. in this field.

It should also be underlined that an important contribution to the exchange of information and experience is made through conferences, seminars and workshops on science and technology education, which are convened or supported by Unesco at the regional and international levels.

The unprecedented development of contemporary knowledge in science and technology means that it is imperative to extend and improve the action undertaken by the Organization in the exchange of information and experience in science and technology education, taking into account the diverse and pressing needs of Member States, especially the developing countries, in this field. It is within this broad framework that the discussions of this meeting will take place.

The Agenda of your meeting foresees firstly a review of the objectives and modalities of the exchange of information on science and technology education. This also comprises a discussion on the nature of the information to be exchanged, on the means for its diffusion and also on its eventual users. It seems appropriate to follow with the examination of the problems linked with the strengthening of national mechanisms and institutions participating in the process of exchange of ideas and information in the field of science and technology education. You are then invited to examine the recent efforts in exchange of information made on the international and regional levels, particularly those of Unesco, and to draw useful lessons for the extension and improvement of this work.

Finally, an important part should be given in your discussions to the analysis of the priorities and modalities for international and regional co-operation in this field. This co-operation can be carried out on two levels at the same time - among countries of the same region and between regions. In this perspective, Unesco will continue to collaborate in the promotion of exchange of ideas and experience, to encourage innovation and to assist countries in their efforts to improve their science education programmes.

You are therefore invited to determine the priority areas for international action, with particular attention to the needs of the developing countries, and to formulate suggestions for possible future action in the exchange of ideas and information on science and technology education. This last point is of special importance since your conclusions and suggestions will be taken into account when

drawing up Unesco's future programme of activities.

With my most sincere wishes for a week of stimulating and fruitful exchange, I declare the meeting open.

ANNEX III

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ANNEX IV

LIST OF DOCUMENTS

ED-82/CONF.620/1	Agenda
ED-82/CONF.620/2	Rules of Procedure
ED-82/CONF.620/3	Discussion Guide
ED-82/CONF.620/4	Working Paper
ED-82/CONF.520/5	Provisional Timetable

Information Documents

ED-82/CONF.620/INF.1	Activities of Unesco Regional Offices for Education in View of the Exchange of Information on Science and Technology Education
ED-82/CONF.620/INF.2	Two Case Studies on Improving National Capacities for Participation in the Exchange of Information on Science and Technology Education
ED-82/CONF.620/INF.3	Exchange of Information : the IBE Experience